

## Appendix A

## Clean Copy of All Claims as Amended

1. A method of modeling circulation in a living subject, such method comprising the steps of:

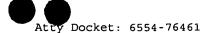
developing a pressure and flow model of an arterial circulatory system for living subjects in general;

correcting the model of the circulatory system to substantially conform to a specific arterial anatomy and physiology of the living subject;

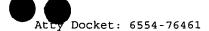
calculating a flow of the circulatory system of the living subject based upon the corrected model; and

calculating a flow of the circulatory system based upon a selected blood flow perturbation.

- 2. The method of modeling as in claim 1 wherein the step of developing the model further comprises adopting the Circle of Willis.
- 3. The method of modeling as in claim 1 wherein the step of correcting the model further comprises selecting a vessel of the model.
- 4. The method of modeling as in claim 3 wherein the step of selecting a vessel of the model further comprises identifying a general area of a corresponding vessel in an image of the living subject.



- 5. The method of modeling as in claim 4 wherein the step of identifying the corresponding vessel further comprises localizing the corresponding vessel in 3-dimensional space.
- 6. The method of modeling as in claim 5 wherein the step of localizing the corresponding vessel further comprises measuring a diameter of the corresponding vessel.
- 7. The method of modeling as in claim 6 further comprising tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.
- 8. The method of modeling as in claim 7 further comprising updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.
- 9. The method of modeling as in claim 8 wherein the step of calculating the cerebral flow further comprises using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.
- 10. The method of modeling as in claim 9 wherein the step of calculating the cerebral flow further comprises using a Navier-Stokes momentum equation.
- 11. The method of modeling as in claim 9 wherein the step of calculating the cerebral flow further comprises using an equation of state relating a local pressure to a local artery size.



12. Apparatus for modeling circulation within a living subject, such apparatus comprising:

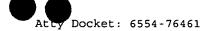
a pressure and flow model of an arterial circulatory system for living subjects in general;

means for correcting the model of the circulatory system to substantially conform to a specific arterial anatomy and physiology of the living subject;

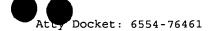
means for calculating a flow and pressure of the circulatory system of the living subject based upon the corrected model; and

means for calculating a flow and pressure of the circulatory system based upon a selected blood flow perturbation.

- 13. The apparatus for modeling as in claim 12 wherein the cerebral circulation model further comprises the Circle of Willis.
- 14. The apparatus for modeling as in claim 12 wherein the means for correcting the model further comprises means for selecting a vessel of the model.
- 15. The apparatus for modeling as in claim 14 wherein the means for selecting a vessel of the model further comprises means for identifying a general area of a corresponding vessel in an image of the living subject.
- 16. The apparatus for modeling as in claim 15 wherein the means for identifying the corresponding vessel further comprises means for localizing the corresponding vessel in 3-dimensional space.



- 17. The apparatus for modeling as in claim 16 wherein the means for localizing the corresponding vessel further comprises means for measuring a diameter of the corresponding vessel.
- 18. The apparatus for modeling as in claim 17 further comprising means for tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.
- 19. The apparatus for modeling as in claim 18 further comprising means for updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.
- 20. The apparatus for modeling as in claim 19 wherein the means for calculating the cerebral flow further comprises means using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.
- 21. The apparatus for modeling as in claim 20 wherein the means for calculating the cerebral flow further comprises means using a Navier-Stokes momentum equation.
- 22. The apparatus for modeling as in claim 21 wherein the means for calculating the cerebral flow further comprises means using an equation of state relating a local pressure to a local artery size.



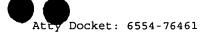
23. Apparatus for modeling circulation in a living subject, such apparatus comprising:

a pressure and flow model of an arterial circulatory system for living subjects in general;

a correction processor adapted to correct the model of the circulatory system to substantially conform to a specific arterial anatomy and physiology of the living subject; and

a flow processor adapted to calculate a flow and pressure of the circulatory system of the living subject based upon the corrected model and a flow and pressure of the circulatory system based upon a selected flow perturbation.

- 24. The apparatus for modeling as in claim 23 wherein the cerebral circulation model further comprises the Circle of Willis.
- 25. The apparatus for modeling as in claim 23 wherein the correction processor further comprises a cursor adapted to select a vessel of the model.
- 26. The apparatus for modeling as in claim 25 wherein the correction processor further comprises a pixel processor adapted to process pixel data of the general area of the corresponding vessel to locate a boundary area between the corresponding vessel and surrounding tissue.
- 27. The apparatus for modeling as in claim 26 wherein the pixel processor further comprises a distance processor adapted to measure a diameter of the corresponding vessel.



- 28. The apparatus for modeling as in claim 27 wherein the pixel processor further comprises a tracing processor adapted to trace the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.
- 29. A method of modeling a surgical alteration of circulation in a living human subject, such method comprising the steps of:

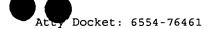
developing a pressure and flow model of an arterial circulatory system for living subjects in general;

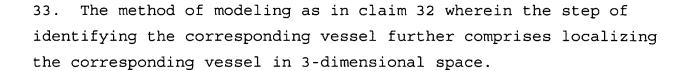
correcting the model of the circulatory system to substantially conform to a specific arterial anatomy and physiology of the living subject;

perturbing the corrected model of the circulatory system; and

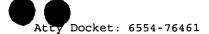
determining a set of flow and pressure changes occurring within the circulatory system as a result of the perturbation.

- 30. The method of modeling as in claim 29 wherein the step of developing the model further comprises adopting the Circle of Willis.
- 31. The method of modeling as in claim 29 wherein the step of correcting the model further comprises selecting a vessel of the model.
- 32. The method of modeling as in claim 31 wherein the step of selecting a vessel of the model further comprises identifying a general area of a corresponding vessel in an image of the living subject.





- 34. The method of modeling as in claim 33 wherein the step of localizing the corresponding vessel further comprises measuring a diameter of the corresponding vessel.
- 35. The method of modeling as in claim 34 further comprising tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.
- 36. The method of modeling as in claim 35 further comprising updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.
- 37. The method of modeling as in claim 36 wherein the step of calculating the cerebral flow further comprises using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.
- 38. The method of modeling as in claim 38 wherein the step of calculating the cerebral flow further comprises using a Navier-Stokes momentum equation.
- 39. The method of modeling as in claim 38 wherein the step of calculating the cerebral flow further comprises using an equation of state relating a local pressure to a local artery size.
- 40. Apparatus for modeling a surgical alteration of circulation in a living human subject, such apparatus comprising:
- a pressure and flow model of an arterial circulatory system for living subjects in general;

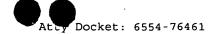


means for correcting the model of the circulatory system to substantially conform to the physiology of the living subject;

means for perturbing the corrected model of the circulatory system; and

means for determining a set of flow and pressure changes occurring within the model of the circulatory system as a result of the perturbation.

- 41. The apparatus for modeling as in claim 40 wherein the means for correcting the model further comprises means for selecting a vessel of the model.
- 42. The apparatus for modeling as in claim 41 wherein the means for selecting a vessel of the model further comprises means for identifying a general area of a corresponding vessel in an image of the living subject.
- 43. The apparatus for modeling as in claim 42 wherein the means for identifying the corresponding vessel further comprises means for localizing the corresponding vessel in 3-dimensional space.
- 44. The apparatus for modeling as in claim 43 wherein the means for localizing the corresponding vessel further comprises means for measuring a diameter of the corresponding vessel.
- 45. The apparatus for modeling as in claim 44 further comprising means for tracing the boundary into adjacent areas in three-dimensional space to locate respective ends of the corresponding vessel.
- 46. The apparatus for modeling as in claim 45 further comprising means for updating the model based upon the measured diameter and locations of the respective ends of corresponding vessel.



- 47. The apparatus for modeling as in claim 46 wherein the means for calculating the cerebral flow further comprises means using a one-dimensional, explicit, finite difference algorithm based upon a conservation of mass equation.
- 48. The apparatus for modeling as in claim 47 wherein the means for calculating the cerebral flow further comprises means using a Navier-Stokes momentum equation.
- 49. The apparatus for modeling as in claim 48 wherein the means for calculating the cerebral flow further comprises means using an equation of state relating a local pressure to a local artery size.
- 50. A method of modeling a surgical alteration of circulation in a predetermined arterial circulatory system of a living human subject, such method comprising the steps of:

developing a pressure and flow model of the arterial circulatory system for living subjects in general;

correcting the model to substantially conform a specific arterial anatomy and physiology of the living subject;

perturbing the corrected model; and

determining a set of flow and pressure changes occurring within the corrected model as a result of the perturbation.